Journal of Basic Education Research
Vol. 6, No. 2, May 2025, pp. 313~321
ISSN: 2716-3725, DOI: 10.37251/jber.v6i2.1787

Countdown Manipulatives: Accelerating the Subtraction Proficiency of the Grade Two Pupils

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Article Info

Article history:

Received Apr 2, 2025
Revised Apr 27, 2025
Accepted May 29, 2025
OnlineFirst May 31, 2025

Keywords:

Countdown manipulatives
Innovation
Learner performance
Mathematics

ABSTRACT

Purpose of the study: This study aimed to improve the mastery of subtraction among Grade 2 pupils at Bahong Elementary School through the use of countdown manipulative materials: Take-off Visualization, Improvised Wheel Clock Count, and Sequential Ladder Count.

Methodology: The respondents consisted of 32 Grade 2 pupils, and data were gathered using pretest and posttest questionnaires. Descriptive statistics and a t-test were used for data analysis. The results revealed that the pupils' mastery level in subtraction improved significantly after the intervention, with the overall posttest Mean Percentage Score (MPS) reaching 93.81%, which is described as "Closely Approximating Mastery." A paired t-test analysis indicated a significant difference in the learners' performance before and after using the manipulative materials, demonstrating the effectiveness of the intervention.

Main Findings: The study found that countdown manipulatives effectively improved Grade 2 pupils' subtraction skills, with the Improvised wheel clock count being the most preferred due its simplicity. These tools helped bridge learning gaps and enhance mathematical understanding. The findings highlight the value of using intercative and innovative materials to boost learner engagement and performance in mathematics.

Novelty/Originality of this study: The originality of this study lies in its innovative use of countdown manipulative materials, Take-off Visualization, Improvised Wheel Clock Count, and Sequential Ladder Count to enhance subtraction mastery among Grade 2 pupils. Unlike traditional teaching methods, these manipulatives provide interactive, visual, and hands-on learning experiences tailored to young learners.

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1. INTRODUCTION

Mathematics profoundly shapes how people understand the world, enabling pattern recognition, relationship quantification, and prediction of outcomes [1]. Despite its importance, improving pupils' performance in mathematics remains a persistent challenge. Many learners struggle with basic operations and mathematical reasoning, resulting in low proficiency and achievement [2]. In the Philippines, Baclig [3] reported in the TIMSS 2019 study that Filipino pupils could only perform basic operations with one- or two-digit numbers, and many found it difficult to solve even simple problems. Leongson [4] emphasized that Filipino learners "excel in knowledge acquisition but are weak in problem-solving and application." Similarly, Fleisch [5] revealed that South African pupils performed poorly in mathematics due in part to the lack of instructional

manipulatives in the classroom, suggesting that materials and teaching methods are essential components of effective learning.

Studies by Biotenbeck [6] and Clement [7] have attributed poor mathematical performance to ineffective instructional strategies and teacher practices. Tata [8], in a Nigerian context, asserted that "negative attitudes toward mathematics, poorly trained teachers, and the absence of learning aids are key contributors to students' low achievement." In response to such challenges, the National Council of Teachers of Mathematics (NCTM) recommended the use of manipulatives to strengthen conceptual understanding, stating that "students gain a deeper understanding when they build or model a concept with physical materials" [9]. Shaw [10] added that manipulatives "strengthen relationships between mathematical ideas and support long-term retention," while Copley [11] explained that they allow students to "construct their own understanding" through hands-on engagement.

Despite these established benefits, many classrooms—especially in low-resource schools—still rely heavily on traditional methods such as seatwork and rote learning, minimizing opportunities for interactive learning [12]. Barrera [13] found that students exposed to manipulative-based teaching significantly outperformed those in conventional setups. Marley and Selig [14] noted that "physical interaction with mathematical tools helps encode information visually and kinesthetically," reinforcing understanding. Boz et al. [15] confirmed that manipulative use positively impacts early mathematical development.

The novelty of this study lies in its introduction of context-specific, teacher-made countdown manipulatives—the Take-off Visualization, Improvised Wheel Clock Count, and Sequential Ladder Count—developed to improve subtraction proficiency among Grade 2 pupils. Unlike previous studies that used commercial materials, this research highlights cost-effective, locally crafted tools suited to the Philippine primary education context. Furthermore, it fills a gap by focusing specifically on subtraction, a fundamental skill often overshadowed by broader arithmetic studies.

However, the study acknowledges certain limitations. It was conducted in a single public elementary school with a limited number of Grade 2 participants, which may affect the generalizability of the findings. Additionally, long-term effects on retention and higher-order mathematical thinking were not assessed. Environmental factors such as home support and varying learner readiness were also not controlled. Nevertheless, this research contributes meaningfully to ongoing efforts to improve mathematical instruction in resource-constrained environments, providing evidence that "teacher innovation using locally available materials can enhance learner engagement and performance in mathematics" [16].

Based on the second-quarter Mathematics Mean Percentage Scores (MPS) from SY 2021-2022 and SY 2022-2023, Grade 2 pupils exhibited low proficiency levels, scoring 43.3% and 45%, respectively. To address these learning gaps, the researcher developed Countdown Manipulatives, including Take-off Visualization, Improvised Wheel Clock Count, and Sequential Ladder Count (TIS). These instructional materials aim to accelerate subtraction proficiency among pupils. The Countdown Manipulatives facilitate conceptual understanding by allowing pupils to work with numbers, recognize relationships, and retain mathematical information.

This study aimed to increase the mastery of subtraction competency among Grade 2 pupils using Take-off Visualization, Improvised Wheel Clock Count, and Sequential Ladder Count. The researcher designed Countdown Manipulatives as instructional tools for use in classroom instruction, exercises, contests, and games. These materials visualize and represent subtraction problems, aiding conceptual understanding and foundational mathematics skills. Each manipulative was introduced progressively, focusing on the prescribed competencies for subtraction in Quarter 2, Weeks 1 to 7.

2. RESEARCH METHOD

2.1 Research Design

This study used a one-group pretest-posttest quasi-experimental design to determine the effectiveness of countdown manipulatives in improving the subtraction proficiency of Grade 2 pupils. This design is widely applied in classroom settings where random assignment is not practical, but meaningful instructional interventions can be evaluated for their impact on learning outcomes [1]. It allows researchers to observe changes in pupil performance before and after the intervention, thus assessing its effectiveness in a real classroom context [2].

2.2 Research Subjects

The research participants included 45 Grade 2 pupils from a public elementary school in the Philippines. The entire class was included in the study using purposive sampling, based on their exposure to subtraction topics and similar learning profiles. Ethical standards were upheld by securing informed consent

from school authorities and parents or guardians, following the guidelines of the British Educational Research Association [3].

2.3 Research Instruments

To collect data, the researcher used a teacher-made pretest and posttest, both composed of 25 multiple-choice questions focused on subtraction involving one- and two-digit numbers. The content was validated by expert mathematics teachers to ensure content alignment with the K to 12 Mathematics Curriculum. The countdown manipulatives developed and used during the intervention included:

- Take-off visualization,
- Improvised wheel clock count, and
- Sequential ladder count.

These were designed to be interactive, learner-friendly, and visually engaging, providing pupils with hands-on experiences to better understand subtraction. Reliability of the test instruments was verified using the test-retest method, and results were analyzed through Pearson correlation to ensure consistency and credibility of data [4].

2.4 Research Procedure

The intervention was conducted over seven weeks. It began with the administration of the pretest to determine the pupils' initial performance in subtraction. For the next several weeks, the three countdown manipulatives were introduced sequentially, starting with Take-off Visualization and Improvised Wheel Clock Count, followed by Sequential Ladder Count in the later phase. These materials were integrated into regular math lessons and used repeatedly to reinforce subtraction skills. Throughout the intervention, the teacher monitored pupil participation, addressed misconceptions, and encouraged hands-on learning. At the end of the treatment period, a posttest was administered to measure improvement in subtraction proficiency.

2.5 Data Analysis

The study employed descriptive statistics to analyze the collected data. Mean scores and gain scores from pretest and posttest results were computed to assess learning improvement. According to Vetter [5], descriptive statistics are essential in educational research for organizing, summarizing, and interpreting numerical data in a meaningful way. Furthermore, Mean Percentage Scores (MPS) were used to determine the level of mastery of each pupil, consistent with the Department of Education standards for student performance evaluation.

A pretest was administered to determine the academic performance of the learners in subtraction before the employing of the intervention. Afterwards, Take- off visualization, Improvised wheel clock count, and sequential ladder count were used. At the end, a posttest was given to determine the performance level of the learners after the treatment. Descriptive statistics were used to analyze the data. Descriptive statistics are specific methods used to calculate, describe and summarize collected research data in a logical, meaningful, and efficient way (Vetter, 2017). To qualify the data on the level of mastery of the learners, Mean Percentage Scores (MPS) was used. TheMastery level is shown below.

Table 2: Mastery Level (DepEd Meno No. 160 s. 2012)

MPS	Descriptive Equivalent
96% - 100%	Mastered
86% - 95%	Closely Approximating Mastery
66% - 85%	Moving Towards Mastery
35% - 65%	Average
15% - 34%	Very Low

3. RESULTS AND DISCUSSION

Countdown manipulative materials were used over seven weeks during the School Year 2024-2025 to enhance the subtraction performance of Grade 2 pupils at Bahong Elementary School, which targeted the different competencies in subtraction. The Countdown Manipulative materials incorporated three sequential activities designed to address the learning gaps of the learners in subtraction. Take-off Visualization provided visual representations to help pupils understand subtraction concepts more clearly. Improvised Wheel Clock Count introduced an interactive method to strengthen subtraction skills, while Sequential Ladder Count offered a structured and systematic strategy to enhance mastery through step-by-step learning.

These activities were integrated into lesson development, preparatory activities, and evaluation stages. The hands-on and multisensory approach aimed to make subtraction engaging and relatable for young learners. The results of the study are presented basing on each competency. They are as follows:

3.1. The mastery indices of Grade 2 learners across different competencies for subtraction skills.

The countdown manipulative materials which involved interactive activities like take-off visualization, improvised wheel clock count, and sequential ladder count, enhanced the learning of Grade 2 pupils in subtraction. Throughout the intervention, various activities were used to teach subtraction in focusing on foundational concepts.

During the teaching-learning process, learners engaged in activities such as Take-off Visualization to visualize subtraction problems, Improvised Wheel Clock Count for interactive and hands-on subtraction practice, and Sequential Ladder Count to reinforce systematic problem-solving approaches. These activities encouraged active participation, improved comprehension, and made learning subtraction more engaging.

Table 1 presents the mastery indices of the different competencies for subtraction. It could be seen that most competencies are under Mastered and Closely Approximating Mastery. Of the competencies assessed, a significant number were under Mastered, while the rest fell under Closely Approximating Mastery. This significant improvement can be attributed to the effect of countdown manipulatives employed during classroom instruction. The posttest results, with an overall score of 93.81, show an improvement, nearing mastery. This significant increase suggests that the intervention was highly effective in addressing the learners' learning gaps and improving their subtraction skills. The learners demonstrated enhanced abilities in visualizing subtraction, performing operations with and without regrouping, and solving both routine and non-routine subtraction problems. The increase in their posttest scores reflects not only a better understanding of the mechanics of subtraction but also a deeper conceptual grasp of the operation.

This improvement in scores indicates that the intervention successfully equipped learners with the skills necessary to achieve proficiency in subtraction. It highlights the effectiveness of the instructional strategies used in addressing learners' needs, allowing them to make substantial progress in a relatively short period of time. The significant jump from the pretest to the posttest demonstrates the intervention's success in bridging the learning gap, and while most students are approaching mastery, continued practice and support will be essential to ensure full mastery and retention of subtraction skills.

For the results of the Mean Percentage Scores (MPS) for each competency, it reflects significant improvements, showcasing the intervention's effectiveness in addressing learners' learning gaps and enhancing their subtraction skills. Each competency demonstrates varying levels of growth, and while most learners have reached or are close to mastery, there are still areas that require further attention to ensure complete proficiency.

Table 1 presents the Pretest and Posttest results on the mastery level of the learners in Subtraction.

Competency	Pretest MPS	MPS	Mastery Level
Visualizes, represents, and subtracts 2-digit numbers	27.87	96.87	Mastered
Subtracts 2-digit numbers with and without regrouping	26.75	96.54	Mastered
Subtracts 3- digit numbers with and without regrouping	17.5	95.78	Mastered
Mentally subtracts 1-digit, 2-digit and 3-digit numbers	28.75	92.5	Closely Approximating Mastery
Solves routine and non- routine problems involving subtraction	8.125	90	Closely Approximating Mastery
Performs operations involving addition and subtraction	14.54	96	Mastered
Solves multi-step problems involving subtraction	13.75	94	Close Approximating Mastery
Overall	19.61	93.81	Close Approximating Mastery

For the competency "Visualizes, represents, and subtracts 2-digit numbers," the MPS increased from 27.87 in the pretest to 96.87 in the posttest. This substantial improvement signifies those learners gained not only a solid understanding of the mechanics of subtraction but also the ability to visualize and represent the operation. Prior to the intervention, learners were likely struggling with the abstract nature of subtraction, which involves more than just memorizing procedures. It requires an understanding of place value and the ability to apply this knowledge in a practical context. The intervention likely contributed significantly to the learners' progress by incorporating manipulatives, and interactive learning methods. These tools allowed learners to physically represent numbers and subtraction processes, which enhanced their understanding and retention. The improvement in this competency shows that when leaners can conceptualize math visually, it provides them with the cognitive tools they need to tackle more advanced mathematical concepts. Moreover, this competency serves as a critical foundation for more complex operations, such as subtraction involving regrouping and larger numbers. It prepares learners for future learning by giving them the ability to deconstruct subtraction problems in

a way that makes sense and reinforces their understanding of mathematical principles. By mastering this skill, learners are more likely to build confidence in their ability to solve more difficult problems as they progress in their mathematical education.

The competency "Subtracts 2-digit numbers with and without regrouping" demonstrated a remarkable increase in the MPS from 26.75 in the pretest to 96.54 in the posttest, reflecting learners' mastery of this more challenging aspect of subtraction. Subtracting 2-digit numbers with regrouping involves a deeper understanding of place value, as it requires learners to carry over digits from one place value column to another. Regrouping is often seen as a challenging skill for younger learners, as it introduces the concept of borrowing or "regrouping" digits across multiple places in a number, such as borrowing from the tens place when the ones place is too small to subtract. The large improvement in the MPS suggests that the intervention effectively addressed these challenges by providing learners with targeted support and practice in regrouping. This significant progress indicates that students have not only learned the procedural steps for subtracting with regrouping, but they also likely developed a deeper understanding of the underlying principles behind regrouping, such as the necessity of borrowing from the next place value. Although the growth in MPS is promising, the initial pretest scores indicate that a portion of the learners still faced difficulties with regrouping.

In the competency "Subtracts 3-digit numbers with and without regrouping," the MPS rose from 17.5 in the pretest to 95.78 in the posttest, marking substantial progress in learners' ability to handle more complex subtraction tasks involving larger numbers and more intricate regrouping procedures. Subtracting 3-digit numbers, particularly those involving regrouping, requires not only the basic skills involved in two-digit subtraction but also a higher level of precision and understanding. This competency introduces a more advanced level of cognitive demand because students need to consider multiple place value columns (hundreds, tens, and ones) when performing the operation. The remarkable improvement in MPS suggests that most learners gained proficiency in this area, overcoming the additional complexity that 3-digit subtraction introduces. This growth likely resulted from the intervention's emphasis on building a strong conceptual understanding of subtraction and its focus on providing hands-on, interactive learning experiences. The increase in MPS reflects that learner are becoming capable of performing subtraction with larger numbers and more detailed regrouping. However, while the overall results are encouraging, some learners may still face difficulties with the more complex steps involved in 3-digit subtraction, especially when dealing with regrouping across multiple place values. To ensure full mastery, continued practice in this area is essential, particularly focusing on the finer points of regrouping, such as carrying over across multiple places. Additional guided practice and individual support would likely help these students reach full mastery.

The competency "Mentally subtracts 1-digit, 2-digit, and 3-digit numbers" saw an impressive increase in the MPS, from 28.75 in the pretest to 92.5 in the posttest. This improvement highlights significant growth in learners ' ability to perform subtraction mentally, which is a key indicator of mathematical fluency. Mental computation skills are valuable because they allow learners to solve problems quickly and accurately without the need for written work or visual aids. Developing mental math skills requires practice and a solid understanding of the number system, and the intervention clearly helped learners improve their ability to perform subtraction across a range of numbers. The increase in MPS suggests that the intervention fostered both speed and accuracy in mental subtraction, allowing learners to carry out subtraction operations confidently and independently. While the improvement in this competency is significant, maintaining mental math fluency requires ongoing practice to ensure that students retain these skills in the long term. The ability to perform mental calculations with speed and accuracy is crucial for mathematical fluency, and continued exposure to mental math exercises will help reinforce these skills. To maintain and further enhance learners' mental math abilities, future lessons should regularly incorporate mental subtraction exercises that challenge students to think critically and solve problems without relying on written steps.

The competency "Solves routine and non-routine problems involving subtraction" showed the most dramatic increase, with the MPS rising from 8.125 in the pretest to 90 in the posttest. This improvement indicates that the intervention effectively enhanced students' problem-solving abilities, particularly in applying subtraction to both routine and more complex, non-routine problems. Routine problems generally follow predictable steps and procedures, whereas non-routine problems involve greater complexity and require students to think critically and creatively. The significant growth in this competency suggests that learners are not only becoming more skilled at solving straightforward subtraction problems but also developing the ability to approach and solve more challenging, real-world problems that require deeper thought and the application of subtraction strategies in novel contexts. The large increase in MPS suggests that learners are more capable of tackling non-routine problems that require them to reason through the steps of subtraction and apply their knowledge to unfamiliar situations. Despite this progress, continued exposure to non-routine problems will further strengthen learners ' critical thinking and problem-solving skills, ensuring that they become more adept at solving complex mathematical challenges. As learners continue to encounter increasingly difficult problems, they will further refine their skills and deepen their understanding of subtraction as a mathematical tool.

The overall results of the study demonstrate that the intervention was highly effective in improving learners ' subtraction skills across a wide range of competencies. Most students have achieved or are close to achieving mastery in several key areas, with significant improvements noted in visualizing subtraction, performing mental subtraction, and solving a variety of subtraction problems. However, there are still areas where some learners require additional practice and support, particularly in more complex subtraction tasks such as regrouping with multi-digit numbers and solving non-routine problems. Moving forward, ongoing practice and targeted instruction will be essential to ensure that all learners reach full proficiency in these areas. The intervention's success in addressing learning gaps underscores the importance of providing engaging and hands-on learning experiences, and future lessons should continue to incorporate these strategies to promote mathematical fluency and mastery.

3.2. The effectiveness of Countdown Manipulatives in enhancing the mastery learning of Grade 2 Learners in Subtraction

The use of countdown manipulative materials particularly Take-off visualization, improvise wheel clock count, and sequential ladder count activities, significantly enhanced the learning of Grade 2 learners in subtraction. These strategies were designed to provide engaging and scaffolded learning experiences, which helped learning gaps and reinforced learners' conceptual understanding of subtraction.

Table 2 presents the pretest and posttest results before and after the intervention using the countdown manipulative materials.

The results show strong evidence of a significant improvement in learners performance following the intervention. posttest results reveal a remarkable increase in performance, with a mean score of 32.19 and a substantially lower standard deviation of 1.86. This shift not only signifies an overall improvement in understanding or skill mastery across the group but also highlights the intervention's ability to reduce variability among the learners. The decrease in standard deviation implies that the intervention was equally effective across a diverse group of learners, helping to bridge the performance gap observed during the pretest phase. This uniform improvement is a critical indicator of the intervention's capacity to address the needs of both low-performing and higher-performing students.

Table 2. Mean and standard deviation difference of the pretest and Posttest score in Countdown manipulatives

Test	Mean	SD	df	Tabulated t value at 0.05 level of significance
Pre test	6.25	3.29	31	2.040
Posttest	32.19	1.86		

The degrees of freedom (df) for this analysis is 31, and the tabulated t-value at the 0.05 level of significance (two-tailed) is 2.040. This critical value is statistically significant. It reveals that the intervention had a significant impact on the learners' performance.

The results underscore the effectiveness of the intervention in enhancing students' learning outcomes. The substantial increase in mean scores from pretest to posttest reflects the success of the countdown manipulatives employed during the intervention. Such strategies likely engaged learners more effectively, clarified key concepts, and provided opportunities for hands-on learning or practice, leading to improved comprehension and application of the material. Moreover, the reduction in the performance gap highlights the inclusivity of the intervention, which appears to have addressed the learning needs of learners across different proficiency levels.

These findings have important implications for educational practice. They suggest that targeted and well-structured interventions can lead to significant improvements in learner performance, even within a relatively short period. The researcher can draw valuable insights from this study, recognizing the importance of employing strategies that cater to diverse learners and fostering an inclusive learning environment. The results also highlight the need for continuous assessment and feedback to monitor learners' progress and adjust instructional approaches as needed.

Altogether, the study revealed the effectiveness of the intervention in significantly improving learners' performance and achieving greater consistency among learners. The marked increase in mean scores and reduction in performance variability underscore the value of intentional, evidence-based teaching practices. These findings emphasize the importance of designing interventions that not only enhance overall performance but also promote equity in educational outcomes, ensuring that all learners have the opportunity to succeed.

3.3. The most preferred manipulative by Grade 2 learners.

The grade 2 learners expressed a strong preference for specific manipulatives used during the intervention, highlighting their effectiveness in enhancing understanding and engagement in subtraction lessons. Among the various tools utilized, the Improved Wheel Clock Count, Sequential Ladder Count, and Take-off visualization were identified the most favored.

The Improvised Wheel Clock Count appealed to learners due to its interactive and hands-on nature. It allowed them to visualize subtraction as a sequential process, making abstract concepts more tangible. Similarly, the Sequential Ladder Count offered a step- by- step approach to subtraction, which many learners found intuitive and easy to follow.

Table 3 presents the most preferred manipulatives by the Grade 2 learners during the intervention.

The results of the manipulative preference survey reveal insightful trends in how Grade 2 pupils engage with different learning tools. The Improvised Clock Wheel emerged as the overwhelming favorite, garnering 23 votes, which translates to 70.97% of the total votes. This high percentage indicates that the Improvised Clock Wheel is not only the most popular choice among the learners but also suggests that it effectively captures their interest and enhances their learning experience. The Improvised Clock Wheel's success can be attributed to its interactive and tangible nature, which is particularly beneficial for young learners. For Grade 2 learners, manipulatives that allow them to physically engage with the content tend to be more effective in maintaining attention and aiding understanding. The Improvised Clock Wheel is likely appealing because it involves both visual representation and motor interaction, enabling learners to practice and internalize subtraction concepts in a way that feels fun and hands-on.

Table 3. The Frequency, percentage and rank of the Countdown manipulatives preferred by the Grade 2.

Manipulative	Frequency	Percentage	Rank
Wheel Clock Count	23	70.97	1
Sequential Ladder Count	7	22.58	2
Take-off Visualization	2	6.45	3

The Improvised Clock Wheel Count, receiving 22 votes (70.97%), emerged as the most preferred manipulative among Grade 2 pupils. This strong preference highlights its effectiveness in engaging learners through visual and tactile interaction. Its circular, moveable design offers immediate feedback and concretizes the subtraction process, aligning with findings by Shaw [1], who emphasized that manipulatives that provide "clear visual representations" enhance comprehension and retention. The hands-on nature of the Clock Wheel Count supports Copley's [2] assertion that physically interactive tools deepen understanding by anchoring abstract concepts in concrete experiences.

In contrast, the Sequential Ladder Count, which garnered 7 votes (22.58%), was moderately favored but significantly less engaging than the Clock Wheel. Its structured, linear format may require more abstract reasoning, which can be challenging for pupils at this developmental stage. This aligns with findings from Larkin [3], who noted that early learners tend to disengage when manipulatives lack immediate interactivity or rely heavily on visualization without physical manipulation. Although it remains a useful instructional tool, the ladder's lower ranking suggests that abstract tools must be supported by scaffolding strategies to be effective for younger learners.

The Take-off Visualization, receiving only 2 votes (6.45%), was the least preferred manipulative. Its low appeal may be attributed to its abstract representation of subtraction, which lacks the tactile or dynamic elements present in the other tools. This finding is consistent with research by Fleisch [4], who found that low-achieving learners benefit less from abstract visualizations and more from manipulatives that offer concrete, manipulable representations. Moreover, Boz, Erdogan, and Uludag [5] highlighted that physical engagement is crucial for developing foundational skills in early mathematics.

These results collectively underscore a key theme in mathematics education: young learners engage more deeply and perform better when they interact with materials that are developmentally appropriate and visually concrete. The high preference for the Improvised Clock Wheel supports Marley and Selig's [6] view that manipulatives that "facilitate nonverbal encoding and enactment" contribute significantly to learning retention. Conversely, the lower rankings of the Ladder Count and Take-off Visualization suggest that abstract tools may hinder conceptual connection unless paired with explicit instruction or learner readiness.

Research novelty is evident in the context-specific design of the countdown manipulatives, particularly the Improvised Clock Wheel Count, which was locally developed and tailored to the learning context of Filipino Grade 2 pupils—an area with limited existing research. The study contributes a practical model for implementing low-cost, high-impact tools in basic math education.

Research limitations include the use of a single class group and non-random sampling, which limits the generalizability of the findings. Future studies could expand the sample size, include control groups, or explore the long-term effects of using countdown manipulatives on mathematical fluency and problem-solving skills.

4. CONCLUSION

The use of countdown manipulative materials—Take-off Visualization, Improvised Wheel Clock Count, and Sequential Ladder Count—significantly enhanced the subtraction performance of Grade 2 pupils at

Bahong Elementary School. The pretest and posttest comparison revealed substantial improvement across key competencies, with most pupils achieving either mastery or closely approximating mastery. The increase in Mean Percentage Scores (MPS) validates that the countdown manipulatives are effective in addressing learning gaps and improving pupils' conceptual understanding, including visualizing subtraction, solving routine and non-routine problems, and performing basic operations involving subtraction and addition. The significant rise in mean scores from 6.25 (pretest) to 31.19 (posttest), alongside a notable reduction in standard deviation, indicates not only individual learning gains but also more uniform mastery across the class. These results highlight the inclusive nature of the intervention, demonstrating its potential to address the diverse learning needs of young learners and reduce disparities in performance. The intervention's systematic, hands-on, and learner-centered approach proved effective in enhancing both individual and collective proficiency in subtraction.

Among the three countdown manipulatives, the Improvised Wheel Clock Count emerged as the most preferred by pupils (70.97%) due to its engaging, tangible, and interactive format. The Sequential Ladder Count (22.58%) was moderately favored, while the Take-off Visualization (6.45%) was the least preferred. These preferences suggest that learners are more responsive to manipulatives that offer concrete, visual, and kinesthetic engagement, aligning with developmental learning theories that emphasize the role of multisensory interaction in early mathematics education. Beyond addressing the initial research questions, this study contributes to a new conceptual understanding: the "Countdown Manipulative Engagement Theory (CMET)", which proposes that mathematical proficiency among early learners can be significantly accelerated through structured, multisensory, and developmentally appropriate manipulatives that follow a countdown-oriented sequence. This emergent concept integrates cognitive development principles with instructional design, positing that learners gain deeper understanding when activities combine visual progression, tactile involvement, and scaffolded numerical sequencing.

ACKNOWLEDGEMENTS

I express my deepest gratitude to the Almighty for granting me wisdom, strength, and perseverance in completing this study and I thank also my family for the continuous support and encouragement.Their guidance has been my source of inspiration throughout this journey.

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